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# Paronellid Collembola from Caves of Central and South America collected by P. Strinati

by

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With 5 figures

## ABSTRACT

Four new species of *Trogolaphysa* Mills are described and illustrated: *T. aelleni* sp. n. (Brazil), *T. guacharo* sp. n. (Venezuela), *T. hauseri* sp. n. (Brazil), *T. strinatii* sp. n. (Mexico). An identification key to the species of this genus is provided. *Paronella carpenteri* Denis, 1925 is redescribed based on material from Mexico and Venezuela.

Some general remarks are made on the evolutionary divergence of the families Entomobryidae, Orchesellidae and Paronellidae.

In the Museum of Natural History in Geneva there is a nice collection of cave Collembola made by Dr. P. Strinati during his long years of exploration in various parts of the world. Among them there has been found a series of Paronellidae from Central and South America, whose research is of special interest not only from the taxonomic, but also from the biogeographical point of view.

Before going further I express my hearty thanks to Dr. P. Strinati for his efforts of collection in the dark environment and also to Prof. V. Aellen, the director of the Geneva Museum, and Dr. B. Hauser for their furnishing me nice occasion to stay and to study these materials in the Museum \*\*.

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\*\* P.S. On this occasion I would like to note that all my Collembolan collection, including types, is now deposited in the Museum of Natural History of Geneva (Switzerland) to be preserved there permanently. Almost the whole collection consists of specimens preserved in alcohol, only few are mounted in Polyvinyl. Many of the separates of my previous papers are also in this Museum to be distributed to the forthcoming researchers.

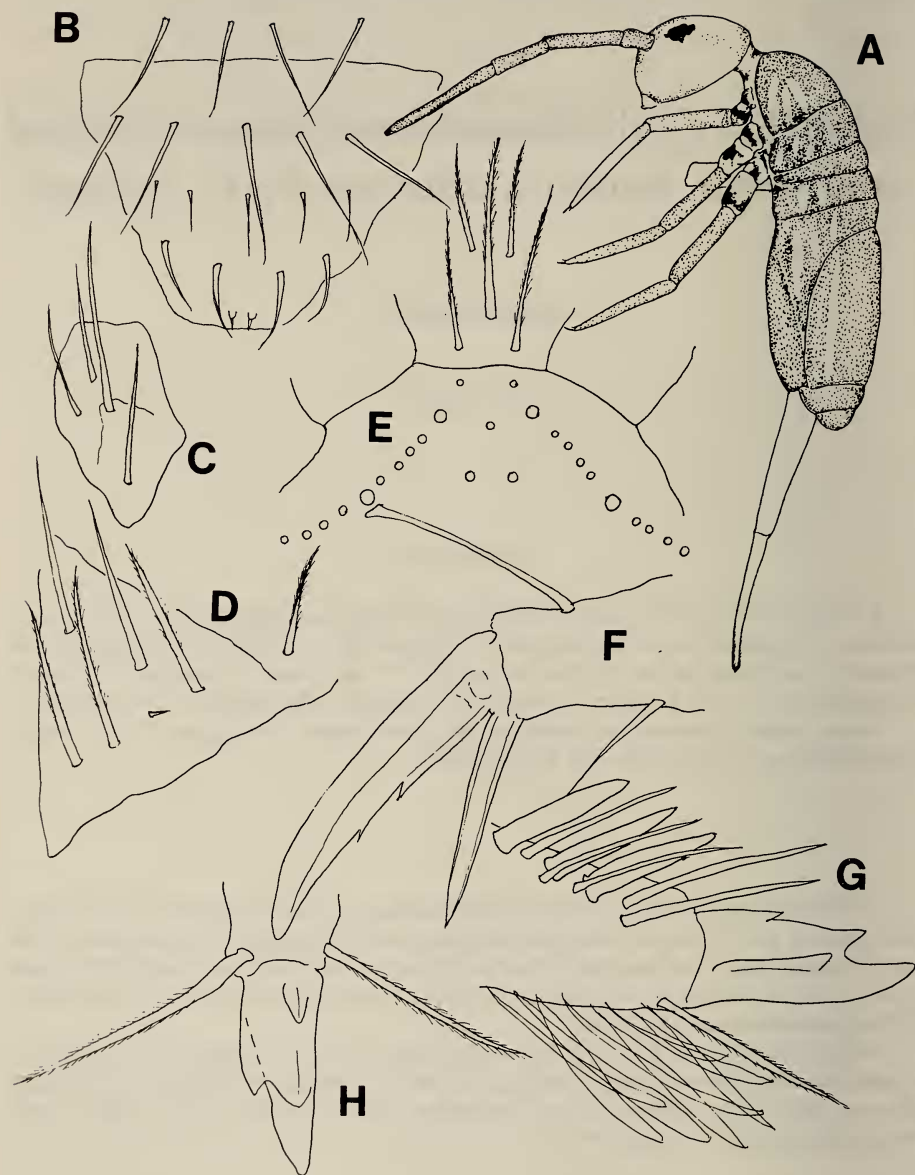


FIG. 1.

*Paronella carpenteri* Denis from Mexico

A: habitus, B: labrum, C: outer maxillary ramus, D: labial basis, E: Chaetal pattern of the frontal area, F: hind claw, G, H: mucro (inner and dorsal view).

**Paronella** Schött, 1893Type species: *Paronella fusca* Schött, 1893

The diagnosis of this classical genus has already received many amendments by various authors and, although the African species are unknown to me in detail, I believe that the following American species belongs to the same genus. With its minutely sculptured scales and by the absence of macrosetae from the main trunk the genus is comparable to *Lepidocyrtus* of Entomobryidae and, therefore, specific identification within the genus seems to be a matter of considerable difficulty.

**Paronella carpenteri** Denis, 1925

Fig. 1

Body length ca. 2.0 mm. Ground colour white, diffusely pigmented to bluish gray, deeper laterally and shallower dorsally, showing many depicted streaks and spots; segmental margins paler. Antennae deeply dark all through the length, but head somewhat brownish in colour and less pigmented; legs dark, deeper near the basis. Furca also slightly dark on manubrium. Ant.: head as 90: 30; ant. segm. ratio as 14: 18: 16: 44. Ant. I, II dorsally heavily scaled, while ant. III, IV unscaled. Ant. IV annulated for the whole length. Head with dark eye-field, with 8 + 8 eyes, from which G, H are smaller than others. Labral setae as 4/5, 5, 4, prelabrals smooth and so long as other labral setae. Labral margin with 1 + 1 minute spinules. Setae of labial basis as M M (r) E/L L. Outer ramus of maxilla with II + 2 setae. Legs unscaled. Unguis typically with a paired inner and one distal tooth. Unguiculus lanceolate, untoothed. Tenent hair not long, but spatulate distally. Trochanteral organ consists of more than 60 slender setae in a quadrangular area. Ventral tube unscaled. Anterior face with many long setae, but none of them modified. Lateral flap bears ca. 15 smooth setae. Furca with man: d as 48: 46. Manubrium ventrally scaled and dorsally only setose, but without any modified setae or spines. Dens ventrally scaled and with two rows of spines, 24 of them in an inner and 26 in an outer row. Mucro quadridentate as usual for the genus. There may be found two long scaly setae at the mucronal end of dens (Fig. 1H). Macrosetae of the frontal area distributed as in Fig. 1E. Setae sensuales and their accompanying setae are present, but not well investigated in the preserved materials.

The species was first described from Guiana (Denis 1925) and later reported from Costa Rica (Denis 1931, 1933), but its identity is not very sure. The edaphic species of the genus in the tropical America must be investigated on the base of richer materials before we may have clear idea of these species. Until that time all of them may be placed in *P. carpenteri*.

Material examined: MEXICO, cave "Resumidero de Xocomanatlán", Chilpancingo, Guerrero, 8.IV.1978, G. Anguérin & P. Strinati coll., 2 specimens; ditto, 8.V.1978, J.-P. Combredet coll., 6 specimens; VENEZUELA, Cueva del Guácharo, Monagas, 17.-18.II.1968, P. Strinati coll., 2 specimens.

**Trogolaphysa** Mills, 1938Type species: *Trogolaphysa maya* Mills, 1938

The genus was first defined as the blind form of *Paronella*. But since there have been found intermittent forms with 5 + 5 or 2 + 2 eyes, this definition can not be supported. In

other body details, however, the two genera are almost the same and the only difference detected is that the prelabral setae are smooth in *Paronella* and barbed in *Trogolaphysa*. Therefore the species below are provisionally placed in *Trogolaphysa*.

As the genus seems to be widely distributed and strongly speciated in each cave of the region, there may be found various species, whose separation might be so difficult as in case of *Pseudosinella*, or even more so, as the setae of labial basis seems to be fixed to MM(r)E/LL.

#### KEY TO THE SPECIES

1. Eyes reduced to 5 + 5 ..... *T. strinatii* sp. n.  
     Eyes reduced to 2 + 2 ..... 2  
     Eyes reduced to 0 + 0 ..... 4
2. Eyes are in a common patch ..... *T. tijucana* (Arlè *et al.*)  
     Eyes separately pigmented ..... 3
3. Unguis and unguiculus not elongate ..... *T. millsi* Arlè  
     Unguis and unguiculus elongate ..... *T. aelleni* sp. n.
4. Unguis and unguiculus elongate ..... *T. hauseri* sp. n.  
     Unguis and unguiculus not elongate ..... 5
5. Unguis with one inner distal tooth ..... *T. guacharo* sp. n.  
     Unguis with two prominent inner distal teeth ..... *T. maya* Mills

#### *Trogolaphysa strinatii* sp. n.

Fig. 2

Body length up to 2.0 mm. Colour almost white all over, but with a slight suffusion of dark pigments on antennae and body. Pale examples are quite white. Ant. I, II are scaled dorsally but ant. III, IV are unscaled and clearly annulated throughout. Ant.: head as 70: 40; ant. segm. ratio as 11: 16: 14: 28. Eye field small, only 5 + 5 cornea could be detected, although their arrangement is not the same in all specimens. Labral setae as 4/5, 5, 4, prelabrals barbed and labral margin with 1 + 1 minute spinules. Outer maxillary ramus with II + 2 setae. Setae of labial basis as MM(r)E/LL. Legs totally unscaled. Unguis differs from *P. carpenteri* having one paired basal and two distal unpaired teeth. Tenent hair slender and slightly spatulate. The Trochanteral organ is an assembly of ca. 40 smooth setae in a quadrangle. Ventral tube unscaled, with many slender, ciliate setae on both faces and lateral flap only with ca. 12 smooth setae. Furca with man: d as 75: 80. Manubrium ventrally scaled and dorsally only with slender, ciliate setae, none of which is differentiated. Each dens with two rows of smooth spines, which may become ciliate near the distal end. Their number is ca. 35 in each row and the area between them are only with ciliate setae. Two distal setae are a little stronger (Fig. 2F), but not especially so. Mucro is quadridentate as usual. The whole body is covered with brownish, minutely ciliate scales. Macrosetae are absent from the trunk except on the fore margin of th. II. Frontal area with macrosetae arranged as in *P. carpenteri* (Fig. 1E).

The species is dedicated to Dr. P. Strinati, the collector of the materials of the present report. It is possibly a troglophile, whose eyes are going to reduce. The difference to *P. carpenteri* is apparently restricted to the eye number and the prelabral setae, which are barbed in this species.

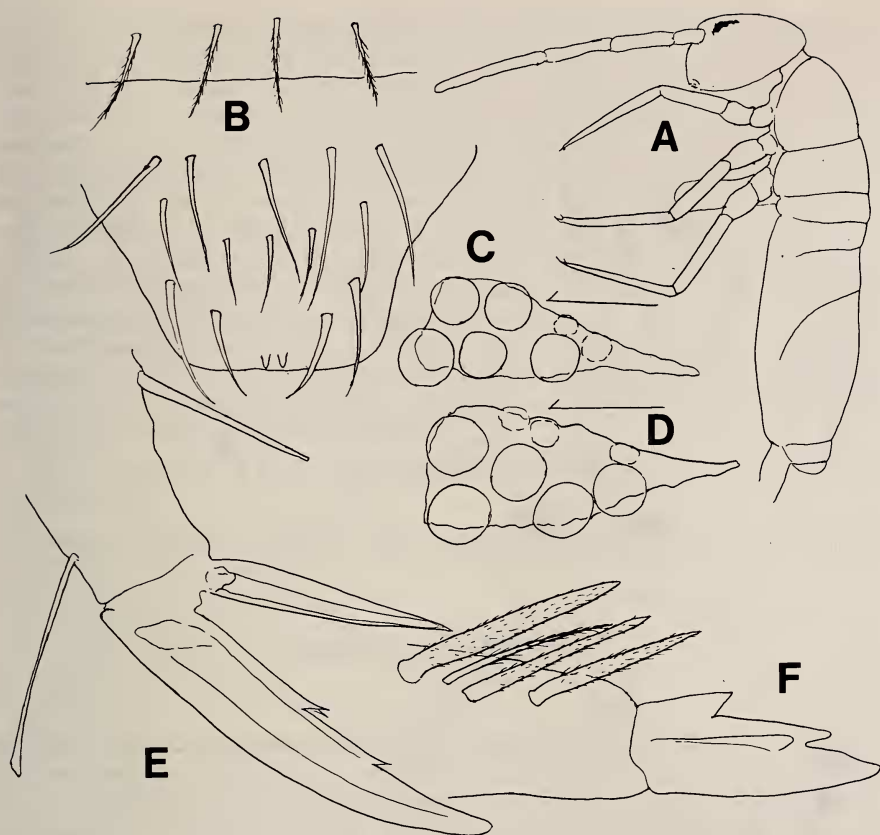


FIG. 2.

*Trogolaphysa strinatii* sp. n.

A: habitus, B: labrum, C, D: eyes, E: hind claw, F: mucro.

TYPE: One specimen from MEXICO: cave "Sima del Borrego", Chilpancingo, Guerrero, 7.IV.1978, P. Strinati coll.

PARATYPES: MEXICO: cave "Sima del Borrego", Chilpancingo, Guerrero, 7.IV.1978, P. Strinati coll., 8 specimens; ditto, 9.IV.1978, P. Strinati coll., 4 specimens; ditto, 5.V.1978, J. P. Combredet coll., 1 specimen; cave "Resumidero de Xocomanatlán", Chilpancingo, 8.V.1978, J. P. Combredet coll., 1 specimen.

*Trogolaphysa aelleni* sp. n.

Fig. 3

Body length ca. 1.5 mm. Totally white. Ant.: head as 12: 5; ant. segm. ratio as 16: 30: 25: 45. Ant. I, II dorsally scaled, but III, IV without scales. Ant. IV lightly annulated. Eyes 2+2, subequally large and separately pigmented. Labrum with setae

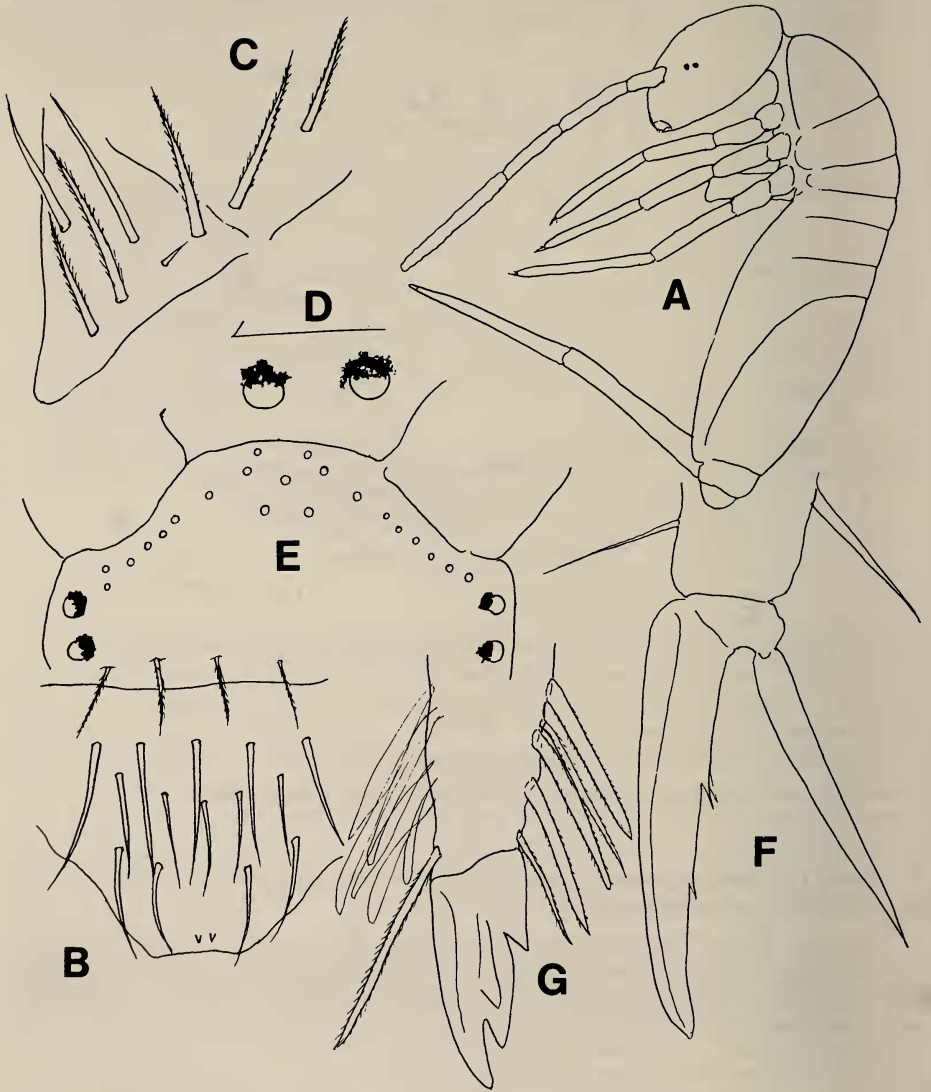


FIG. 3.

*Trogolaphysa aelleni* sp. n.

A: habitus, B: labrum, C: labial basis, D: eyes, E: Chaetal pattern of frontal area, F: hind claw, G: mucro.



4/5,5,4, the prelabrals are small and lightly ciliate. Setae of labial basis as MM(r)E/LL. Legs totally unscaled. Unguis slender, with a pair of inner teeth at the middle and one unpaired tooth on distal two thirds. Unguiculus also elongate, lanceolate and pointed on apex. Tenent hair slender, very short and almost pointed apically. Trochanteral organ composed of ca. 18 smooth setae in a triangle. Ventral tube unscaled, with many long ciliate setae not in a fixed arrangement. Lateral flap with some 10 smooth setae. Terminal tubule seems to have no warty structure. Furca with man: d as 56: 60. Dental spines weakly developed, they can be detected from the basis up to the middle, where they are going to be mixed with the usual strongly developed setae. Mucro typically quadridentate, with a pair of long, ciliate setae near the base. Body scales very thin. Macrosetae of the frontal area as in Fig. 3E, less number than in *T. guacharo*.

The species is dedicated to Prof. V. Aellen. It is concordant with *T. millsii* Arlè, 1939 of Brazil in the status of eyes, but different from it in longer unguis and unguiculus. The inner distal tooth of unguis is quite near the inner proximal pair in the cited species, while it is far distally situated in this new species.

TYPE: One specimen from Grutas das Areias, São Paulo, BRAZIL, 29.-30.VII.1968, P. Strinati coll.

PARATYPES: BRAZIL: Grutas das Areias, São Paulo, 29.-30.VII.1968, P. Strinati coll., 11 specimens.

### ***Trogolaphysa guacharo* sp. n.**

Fig. 4

Body length ca. 1.7 mm. Totally white. Facies Entomobryoid in appearance, but antennae, legs and furca elongate. Ant.: head as 65: 24; ant. segm. ratio as 9: 14: 16: 26. Ant. I, II scaled, ant. III, IV only setose. Ant. IV elongate, clearly annulated and with many quirls of two kinds of setae, the usual ciliate ones and smooth, upright setae. Distal end obscurely rounded and perhaps without bulb. Ant. III-organ with two rods and one blunt seta nearby. Ant. II-organ absent. Head without eyes. Labral setae 4/5,5,4, prelabrals are feebly developed and lightly ciliate. Labral margin with 1+1 minute spinules. Outer maxillary ramus with II+2 setae, all setaceous and pointed. Setae of labial basis as MM(r)E/LL, where r is in reduced form and L-2 is laterally located. Legs without scales. The pair of inner proximal teeth of unguis are unequally large, one inner distal tooth is quite nearby. Unguiculus lanceolate and untoothed; tenent hair feebly developed, short and pointed. Opposite setae of hind legs stout. Hind tibiotarsus without row of smooth setae, but with one large seta at one third of its length. Trochanteral organ composed of ca. 40 smooth upright setae in a triangular area. Ventral tube very long, unscaled and with many slender setae on both sides, becoming longer distally. Lateral flap only with smooth setae, 8-10 in number. Terminal tubule seems to have no warty structure. Furca well extended man: d being 32: 38. Manubrium only scaled ventrally and only setose dorsally. These dorsal setae are not differentiated, but the lateral ones are a little longer than others. Manubrial thickening is not developed and there are 3+3 distal terminal setae, which are ciliate and blunt. Dens dorsally with an inner and an outer row of strong, smooth spines together with some ciliate setae between them. The spines are almost equal in size and ca. 25 in each row. They are stretching in equal distance from the basis up to the mucronal end, where they are ciliate. There are also a pair of long, ciliate setae. Mucro quadridentate; three teeth are dorsally prominent, the fourth is attached to the inner side

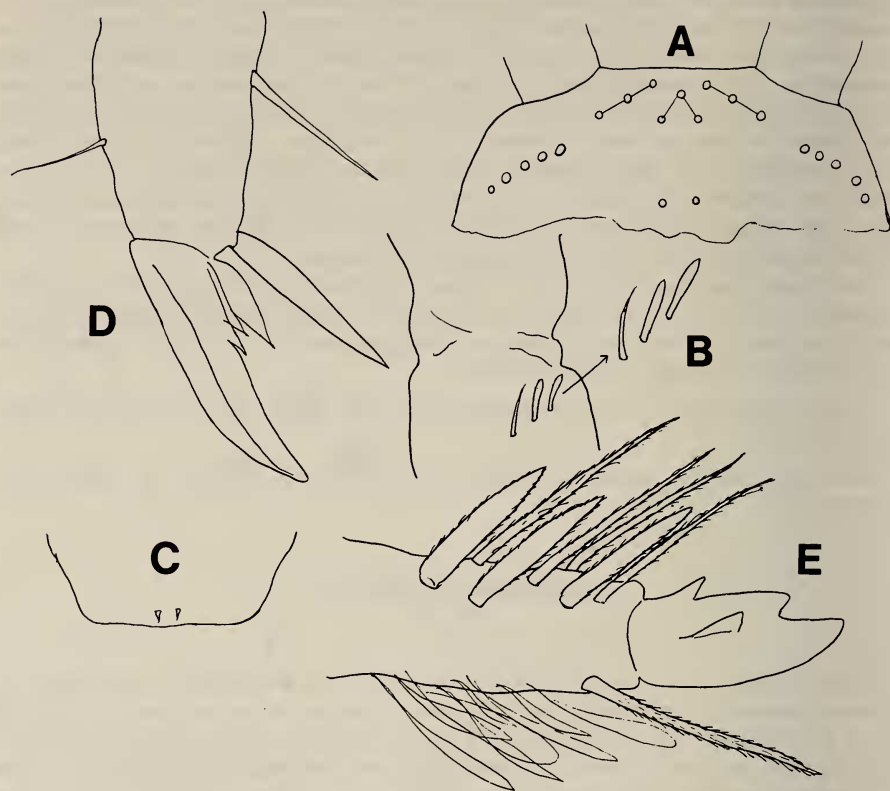


FIG. 4.

*Trogolaphysa guacharo* sp. n.

A: Chaetal pattern of frontal area, B: Ant. III-organ, C: labral margin, D: hind claw, E: mucro.

of mucro. Macrosetae are absent from the trunk. Head with macrosetae only along the fore margin of the frontal area and along the antennal basis, as in Fig. 4A, having 1 + 1 additional setae behind. Abd. II, III have s.s. with accessory scales.

The species differs absolutely from *T. maya* Mills, 1938 of the Yucatan Caves in the form of unguis, as there is one more strong inner tooth in the cited species.

TYPE: One specimen from Cueva Alfredo Jahn, Miranda, VENEZUELA, 21.II.1968, C. Bordon et P. Strinati coll.

PARATYPES: VENEZUELA: Cueva Alfredo Jahn, Miranda, 21.II.1968, C. Bordon et P. Strinati coll., 1 specimen; Cueva del Guácharo, Monagas, 17.-18.II.1968, P. Strinati coll., 3 specimens.



***Trogolaphysa hauseri* sp. n.**

Fig. 5

Body length ca. 1.5 mm. Totally white. Ant.: head as 60: 36; ant. segm. ratio as 6: 16: 14: 25. Ant. I, II dorsally scaled. Ant. III, IV unscaled and not annulated in the two specimens examined. Head without eyes. Labral setae 4/5,5,4, prelabrals barbed, others slender and long. Labral margin with 1 + 1 minute spinules. Setae of labial basis as MM(r)E/LL. Legs unscaled. Unguis very slender, with unequally large inner proximal teeth and without inner distal tooth. Actually there are two ridges attaining to the place, but they do not form a tooth at the junction. Unguiculus also very slender, untoothed. Tenent hair small, feeble and pointed. Trochanteral organ rather poorly developed, com-

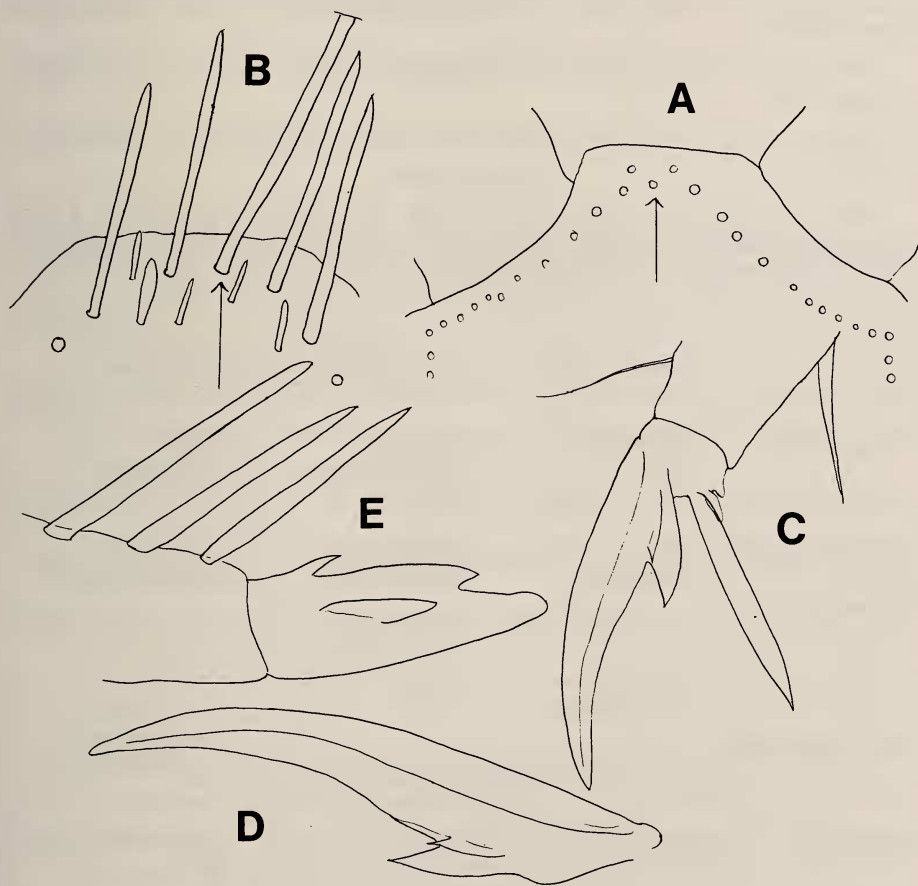


FIG. 5.

*Trogolaphysa hauseri* sp. n.

A: Chaetal pattern of frontal area, B: ditto (proximal part enlarged), C: hind claw,  
D: unguis enlarged, E: mucro.

posed of ca. 15 slender setae in a triangle. Ventral tube unscaled and not differentiated. Furca in ratio as 30: 34. Ventrally heavily scaled and dorsally only with setae. Terminal setae of manubrium 3 + 3, not differentiated. Dens with two rows of strong spines. The inner row is composed of ca. 30 spines, equally large and equidistantly arranged; the outer row is composed of ca. 14 spines, smaller distally and irregularly arranged, so that there are no spines on the basal one fourth on the outer side of dens. Mucro rather elongate, quadridentate as usual of the genus. Macrosetae of the body absent and those on the frontal area strongly reduced, there being only one median seta, small setae around it irregular in arrangement and not fixed in pattern (Fig. 5A, B).

As there are only two specimens known the description above may be incomplete, but still this species may be easily distinguished from other species by the peculiar form of unguis and unguiculus. From *T. aelleni* sp. n., in which the unguis is also elongate, it can be separated by the absence of eyes. The species is dedicated to Dr. Bernd Hauser of the Geneva Museum.

TYPE: One specimen from Gruta da Tapagem, Sao P  ulo, BRAZIL, 27.-28.VII.1968, P. Strinati coll.

PARATYPE: BRAZIL: Gruta da Tapagem, S  o Paulo, 27.-28.VII.1968, P. Strinati coll., 1 specimen.

When we review the whole of the family Paronellidae and compare it with Entomobryidae and Orchesellidae, we may easily find out the near and remarkable coincidence in their diversity, which may be explained by the following table:

	Entomobryidae	Orchesellidae	Paronellidae
Without scales	<i>Entomobrya</i> <i>Sinella</i> etc.	<i>Orchesella</i> <i>Orchesellides</i> etc.	<i>Salina</i> <i>Akabosia</i> etc.
With coarse scales and with few macrosetae	<i>Seira</i> <i>Lepidosira</i>	<i>Dicranocentrus</i> <i>Heteromurus</i>	<i>Callyntrura</i> <i>Dicranocentroides</i>
With fine scales and without macrosetae	<i>Lepidocyrtus</i> <i>Pseudosinella</i>	none?	<i>Paronella</i> <i>Bromacanthus</i> <i>Trogolaphysa</i> <i>Troglopedetes</i>
Derivatives	none	none	Cyphoderidae Oncopoduridae

As already stated in DENIS (1925, p. 262) the genus *Paronella* and its blind form, *Trogolaphysa* have a strong affinity to *Cyphoderopsis* Carpenter, 1917 and to *Troglopedetes* Absolon, 1907 in the general facies. They may be distinguished mainly by

the reduction of antennae as ant. IV is divided into two segments in *Troglopedetes* and shortly reduced in *Cyphoderopsis*. The fact that Paronellidae show a great divergence in the finely scaled phase and even gave rise to the family Cyphoderidae and Oncopoduridae may indicate the very archaic origin of the group and, as also stated by Denis (l.c.), we may assume its origin in the Gondwana continent.

After having inspected now the "true" *Paronella*, this is the place to discuss the status of *Microparonella* Carpenter, 1916, which is quite near *Paronella* except that it is small in size and its unguiculus is distally truncate. However, the genus must be retained to include those species in which, besides the differences mentioned above, the labral margin has 2+2 tubercles instead of 1+1 spinules. Prelabral setae and labial setae are rather thickly built in case of *Microparonella*.

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\* These publications came to my attention after completion of the manuscript. At present we are unable to discuss the identity of *Paronella* and *Troglopedetes* as the African species of *Paronella* (s. str.) are unknown.